Optimizing Laboratory Design for Five Percent Superpave (Superpave5)
History of Design Air Voids

- Marshall Mix Design
  - Set up in late 1940s
  - Design voids set at 3 to 5%

- Marshall Mix Compaction
  - “Standard” rolling train
    - Static Steel Wheel
    - Pneumatic tired
  - 8% will densify under traffic to 4%
    - “Density at end of life = Design Density”
Superpave Mix Design

- “Marshall” concept carried forward
  - Design air voids fixed at 4%
- Recommended compaction
  - Set at 92% Gmm
DENSITY AT END OF LIFE??

Compaction Caused by this
Typical As Constructed Density

NCHRP Report 573
Figure 4.6
Typical “Final” Density

Unchanged from 2 to 4 years

NCHRP Report 573
Figure 4.8

91.8%  94.6%
Superpave 5 Concept

- Mix Design: 5% air voids
- Field Compaction: 95% Gmm

- Higher design air voids
  - 5% instead of 4%
- No change in asphalt content

- Improve Durability
  - Lower air voids in the field
Purdue Experiment

- Three mix designs
  - 9.5-mm (3-10 million)
  - 9.5-mm (10-30 million)
  - 19.0-mm (10-30 million)
## 9.5-mm Mixture Design

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9.5-mm Mixture Gradations

Percent Passing

Sieve Size raised to 0.45 power, mm

N100

Max Density Line
9.5-mm Mixture Gradations

Percent Passing

Sieve Size raised to 0.45 power, mm

N100

N70

Max Density Line
9.5-mm Mixture Gradations

Sieve Size raised to 0.45 power, mm

Percent Passing

N100
N70
N50
Max Density Line
9.5-mm Mixture Gradations

Percent Passing

Sieve Size raised to 0.45 power, mm

- N100
- N70
- N50
- N30
- Max Density Line
Rut Resistance Comparison

Number of Gyrations

Flow Number

- Number of Gyrations vs. Flow Number graph
- Data points for each group
- Group 5/5
- Group 4/7

Legend:
- Group 5/5
- Group 4/7
Laboratory Study Conclusions

- Designs at 5% Air Voids and 95% Gmm Compaction
  - Equal or Greater
    - Stiffness
    - Flow Number
  - Than designs at 4% Air Voids and 93% Gmm Compaction
Georgetown Road

- Reconstruction and widening
- Trial Mix
  - 19 mm
  - 330 lb/yd² (3 inches)
Paving Train
N30 (5% Air Void) Mix
N30 (5% Air Void) Mix
N30 (5% Air Void) Mix
Field Density Control
N30 (5% Air Void) Mix
Gradation (Plate Sample)

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### QA Volumetric Properties

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# QA Core Density

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Loose Research Samples
Research Cores
Testing

- Permeability
- Hamburg Rut Testing
  - Short term aged
  - Long Term Aged
- SCB
  - Short term aged
  - Long Term Aged
Next Step

- Superpave5 mix design set at 50 gyrations
  - Develop Trial Specification

- Let project(s) with Superpave5 specifications
  - Determine Acceptance Tolerances
    - Air voids
    - VMA
    - Density
Thank You

Greetings from Billy Bob